

WHAT IS CLAIMED IS:

1. A method of making a molded component having a molded-in surface texture, using a molding apparatus including a front mold having a front mold surface with a front mold surface texture, and a back mold having a back mold surface opposed to said front mold, said method comprising the following steps:
 - a) providing a cover sheet including a skin film comprising a skin film material, and a foam backing comprising a foam backing material;
 - b) heating said cover sheet so as to heat said skin film to a first temperature equal to or above a melting temperature of said skin film material, and so as to heat said foam backing to a second temperature below a melting temperature of said foam backing material;
 - c) arranging said cover sheet between said front mold and said back mold with said skin film facing toward said front mold and said foam backing facing toward said back mold, and then moving at least one of said front mold and said back mold relatively toward each other with said cover sheet therebetween;
 - d) molding said cover sheet and bringing said skin film into direct contact with said front mold surface so as to mold into said skin film a molded-in surface texture that is the inverse of said front mold surface texture; and

26 e) after said step d), cooling said cover sheet and
27 moving apart at least one of said front mold and said
28 back mold relative to each other.

1 2. The method according to claim 1, wherein said step b) is
2 carried out so that said skin film material of said skin
3 film is transformed from a solid state to a melted viscous
4 liquid state, and so that said foam backing material is
maintained in an elastic foam solid state, and wherein said
step d) is carried out with said skin film material of said
skin film initially still in said melted viscous liquid
state.

5 3. The method according to claim 2, wherein said step d)
6 comprises introducing a pressurized pressure medium into a
gap between said foam backing and said back mold surface,
7 so that said pressure medium presses said foam backing
8 uniformly toward said front mold surface so as to uniformly
9 achieve said bringing of said skin film into direct contact
with said front mold surface, and further comprises
applying a vacuum between said skin film and said front
mold surface.

1 4. The method according to claim 1, wherein said step d)
2 comprises introducing a pressurized pressure medium into a
3 gap between said foam backing and said back mold surface,
4 so that said pressure medium presses said foam backing
5 uniformly toward said front mold surface so as to achieve
6 said bringing of said skin film into direct contact with

7 said front mold surface, and further comprises removing air
8 from between said skin film and said front mold surface.

1 5. The method according to claim 4, wherein said removing of
2 air comprises passive venting of air as said pressure
3 medium presses said foam backing toward said front mold
4 surface.

6. The method according to claim 5, further comprising, after
said passive venting of air, applying a vacuum between said
front mold surface and said skin film.

7. The method according to claim 4, wherein said removing of
air comprises applying a vacuum between said front mold
surface and said skin film.

1 8. The method according to claim 7, wherein said vacuum has a
2 degree of gage vacuum of 0.05 to 0.3 bar below atmospheric
3 pressure.

1 9. The method according to claim 4, wherein said pressurized
2 pressure medium is introduced into said gap and maintained
3 at a gage pressure in a range from 1 to 30 bar.

1 10. The method according to claim 9, wherein said gage pressure
2 is in a range from 5 to 20 bar.

1 11. The method according to claim 4, wherein said pressurized
2 pressure medium is compressed air.

1 12. The method according to claim 4, wherein said step c)
2 further comprises forming a pressure-tight seal between
3 said foam backing and said back mold surface around a
4 perimeter of said back mold.

1 13. The method according to claim 4, wherein said pressurized
2 pressure medium comprises a foaming polymer resin that
3 generates a pressurizing pressure in said gap between said
4 foam backing and said back mold surface as said resin
5 expands and forms a foam.

1 14. The method according to claim 4, wherein said step c)
2 comprises a mechanical pre-molding of said cover sheet
3 against said back mold surface and toward said front mold
4 surface as at least one of said front mold and said back
5 mold moves relatively toward each other, and wherein said
6 introducing of said pressurized pressure medium in said
7 step d) causes a blow-molding of said cover sheet in
8 addition to said mechanical pre-molding.

1 15. The method according to claim 1, wherein said step b) is
2 carried out so that said first temperature of said skin
3 film is in the range from 40°C to 70°C higher than said
4 second temperature of said foam backing.

1 16. The method according to claim 1, wherein said step b) is
2 carried out so that said first temperature of said skin
3 film is in the range from 190°C to 210°C and said second

temperature of said foam backing is in the range from 130°C to 150°C.

17. The method according to claim 1, wherein said cover sheet is oriented with said skin film facing upwardly and said foam backing facing downwardly throughout all of said steps.

18. The method according to claim 1, wherein said step b) comprises contacting said foam backing with a tempered plate and directing heat radiation from an infrared heater at said skin film.

19. The method according to claim 1, further comprising tempering said front mold and said back mold so as to maintain a temperature of said front mold surface and said back mold surface in the range from 50°C to 60°C.

20. The method according to claim 1, wherein said foam backing material is a substantially closed-cell foam that is not air permeable through a thickness thereof, and said skin film material is a thermoplastic polyolefin.

21. The method according to claim 20, wherein said foam backing material comprises a different polymer material than said thermoplastic polyolefin.

22. The method according to claim 20, wherein said foam backing material also comprises said thermoplastic polyolefin.

1 23. The method according to claim 1, wherein said foam backing
2 material comprises a polypropylene foam and said skin film
3 material comprises a polypropylene film.

1 24. The method according to claim 1, further comprising, after
2 said step e), introducing a substrate material between said
3 foam backing and said back mold surface, and then moving at
4 least one of said front mold and said back mold relatively
5 toward each other, so that said back mold surface presses
6 against said substrate material and molds and bonds said
7 substrate material onto said foam backing so as to form a
8 molded substrate from said substrate material.

1 25. The method according to claim 24, wherein said substrate
2 material is a pre-heated sheet of at least one composite
3 material selected from the group consisting of
4 polypropylene and natural fibers, polypropylene and
5 polyester fibers, and polypropylene and glass fibers.

1 26. The method according to claim 24, wherein said substrate
2 material is a polyurethane foam.

1 27. The method according to claim 24, wherein said introducing
2 of said substrate material comprises one of injecting,
3 spraying, pouring and casting said substrate material in a
4 viscous liquid state.

1 28. The method according to claim 24, wherein said step d)
2 comprises introducing a pressurized pressure medium into a
3 gap with a defined gap spacing size between said foam
4 backing and said back mold surface, and wherein said
5 introducing of said substrate material comprises
6 introducing said substrate material into said gap with said
7 defined gap spacing size between said foam backing and said
8 back mold surface that had been occupied by said pressure
medium in said step d).

29. The method according to claim 1, wherein said molded-in
surface texture comprises one of an artificial leather
grain, an artificial wood grain, a raised text, an indented
text, a raised logo, an indented logo, a geometric
repetitive pattern of protrusions, and a geometric
repetitive pattern of indentations.

1 30. A method of making a molded component using a molding
2 apparatus including a front mold having a front mold
3 surface with a front mold surface texture, and a back mold
4 having a back mold surface opposed to said front mold, said
5 method comprising the following steps:

6 a) providing a cover sheet including a skin film
7 comprising a skin film material, and a foam backing
8 comprising a foam backing material;

9 b) heating said cover sheet so as to heat said skin film
10 to a first temperature equal to or above a melting
11 temperature of said skin film material, and so as to

- 12 heat said foam backing to a second temperature below
13 a melting temperature of said foam backing material;
- 14 c) arranging said cover sheet between said front mold and
15 said back mold with said skin film facing toward said
16 front mold and said foam backing facing toward said
17 back mold, and then moving at least one of said front
18 mold and said back mold relatively toward each other
19 with said cover sheet therebetween, so as to
20 mechanically pre-mold said cover sheet toward said
21 front mold surface;
- 22 d) forming a pressure-tight seal between said foam
23 backing and said back mold surface, and introducing
24 pressurized air at a pressure in a range from 1 bar to
25 30 bar into a gap between said foam backing and said
26 back mold surface so as to blow-mold said cover sheet
27 and press said skin film against said front mold
28 surface and thereby mold into said skin film a
29 molded-in surface texture that is an inverse of said
30 front mold surface texture;
- 31 e) during said step d), venting air from between said
32 skin film and said front mold surface;
- 33 f) applying a vacuum between said skin film and said
34 front mold surface;
- 35 g) moving apart at least one of said front mold and said
36 back mold relative to each other; and
- 37 h) introducing a substrate material between said foam
38 backing and said back mold surface, and then moving at
39 least one of said front mold and said back mold
40 relatively toward each other, so that said back mold

41 surface presses against said substrate material and
42 molds and bonds said substrate material onto said foam
43 backing so as to form a molded substrate from said
44 substrate material.

1 31. An apparatus for making a molded component having a
2 molded-in surface texture, comprising a front mold tool and
3 a back mold tool, wherein:

4 said front mold tool comprises a front mold having a
5 front mold surface with a front mold surface texture that
6 has been engraved, milled, stamped, embossed or etched into
7 said front mold surface;

8 said front mold tool has a vacuum plenum therein, and
9 a vacuum port that communicates into said vacuum plenum and
10 is adapted to be connected to a source of vacuum;

11 said front mold tool has a plurality of vacuum holes
12 communicating therethrough from said front mold surface to
13 said vacuum plenum;

14 said back mold tool comprises a back mold having a
15 back mold surface opposed to said front mold surface, an
16 air supply port adapted to be connected to a supply of
17 pressurized air, a plurality of air holes in said back mold
18 surface, and at least one air passage communicating from
19 said air supply port to said air holes; and

20 said back mold tool further comprises a perimeter seal
21 frame that is connected to said back mold and extends
22 around a perimeter of said back mold, and that forms a
23 pressure-tight seal between said front mold and said back
24 mold when said molds are closed toward each other.

1 32. The apparatus according to claim 31, wherein said front
2 mold is a massive steel front mold, and each one of said
3 vacuum holes includes a respective laser-bored hole that
4 opens through said front mold surface.

1 33. The apparatus according to claim 32, wherein each said
2 laser-bored hole has a diameter not greater than 0.5 mm.

3 34. The apparatus according to claim 32, wherein each one of
4 said vacuum holes further includes a mechanically-bored
hole that has a larger diameter than said laser-bored hole
and that extends and communicates from said laser-bored
hole to said vacuum plenum.

1 35. The apparatus according to claim 31, wherein said front
2 mold comprises a galvanically formed zinc mold, and each
3 one of said vacuum holes comprises a chemically etched or
4 milled pore hole through said zinc mold.